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GINZEL

Design for a Grand Stand

Civil Engineering

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DESIGN
FOR A
GRAND STAND

...BY...

Carl Louis Ginzel

THESIS FOR THE DEGREE OF BACHELOR OF SCIENCE
IN CIVIL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS

PRESENTED JUNE, 1904

UNIVERSITY OF ILLINOIS

May 27, 1904 190

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

CARL LOUIS GINZEL

ENTITLED DESIGN FOR A STEEL-FRAME GRAND STAND

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Civil Engineering.

Isaac Baker

HEAD OF DEPARTMENT OF

Civil Engineering

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UNIVERSITY OF ILLINOIS

MAY 21, 1911

THIS IS TO CERTIFY THAT THE THESIS SUBMITTED HEREIN BY

CARL LEWIS STEEL

ENTITLED DESIGN FOR A STEEL-TANK BRAND TANK

IS APPROVED BY ME AS FULFILLING THE PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Civil Engineering

Robertson

Civil Engineering

HEAD OF DEPARTMENT OF

Introduction.

There are few grand stands in existence that are made entirely of steel. The writer, after a search thru the University of Illinois library, has found only two articles concerning steel grand stands which have been built previous to the year of 1903. One of these articles describes a grand stand erected at Monmouth Park, N. J., and the other concerns a somewhat similar structure at Yonker, N. Y. The writer has personally visited the grand stand at Delmas Race Track at St. Louis, Mo., which with the exception of the seats and the columns supporting them, is made of steel.

Object.

The object of this thesis is to design a fire-proof grand stand, the framework to be made entirely of steel and to be designed according to the specifications

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found in Ketchum's Steel Mill Buildings. It is the purpose to design a structure that may be economically constructed.

Location.

In view of the necessity of having a grand stand at the University of Illinois, the writer has considered Illinois Field as being the probable location of this design. No contour map was made as the grounds are practically level and no excavation is necessary except for the column footings.

At the above location it would be better to build a grand stand having a single rather than a double tier of seats. In the first place a structure with two tiers of seats would be constructed only in case there is limited space upon which to build, or where the land is so expensive as to warrant the saving of space by increasing the height. Neither of the above conditions occur at Illinois Field. Unless the width be made small, two tiers



of seats at a slant of one to three would necessitate too great a height to be practical; while a less pitch would be inadvisable on account of the probability of one person obstructing the view of the person seated directly behind him. Although a two story structure requires only one roof, the wind acting upon it at such a great height causes excessive bending moments in the columns. The latter, together with the weight of an extra tier of seats, require the seat trusses and columns to be made so much heavier as to compensate for the extra expense for the roof in a one story structure. The writer, after making a rough estimate of the relative cost of a one and of a two story structure, concluded that the former would be the more economical.

The Design.

The grand stand here proposed is made up of eight fifty-foot sections which are identical. It is therefore necessary to de-

scribe only one of these sections.

The roof truss is of the simple Fink type. In the rear a column supports each truss, but in front only every third truss rests on a column. The object is to have as few obstructions as possible in front to obscure the view of the people in the seats. A beam of built up section supports the front ends of the intermediate trusses. The purlins are placed at the panel points of these trusses, and support a roofing made of corrugated steel which is fastened by means of clinch nails. For details of the roof trusses, the roofing, and the columns see Plate 2. For the general dimensions see Plate 3.

The single tier of seats rests upon steel columns. To resist the wind, a system of sway bracing is placed between these columns, the rear columns being braced both longitudinally and transversely. For details of seats and bracings see Plate 2.

The foundations are made of concrete, shaped like the frustum of a pyramid.

For details see Plate 3.

To resist the wind on the gable end of the roof, bracing is placed between the two roof trusses at each end of the structure, in the plane of their upper chords. The purlins act as struts to transfer the wind stresses to the lateral bracing.

In determining the stresses in the columns and trusses the following assumptions were made: that the rear columns are fixed by the seats; that they take up all the bending due to wind; that the front columns are not fixed and that the reactions upon them due to the wind are vertical.

The wind stresses are calculated graphically. For stresses see Plate 1. The members are designed according to the specifications found in Ketchum's Steel Mill Buildings. Tension members are designed to take a stress of 16,000# per square inch of net section. The allowable unit stress for compression members is given by the following formula:

$$P = 16000 - 70 \frac{1}{r}$$

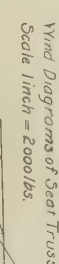
P = Allowable stress per square inch.

l = Length of member in inches.

r = Least radius of gyration.

No metal less than $\frac{1}{4}$ " inch in thickness is used. The minimum size of angles used is $2" \times 2" \times \frac{1}{4}"$, which in several members gives an excess of metal, but it would be impractical to use shapes with a smaller section in so large a structure.

In the above design the writer does not go into minute details. Only the most essential features are described, with a view of giving a general idea of the construction and methods employed.

STRESSES IN SEAT TRUSSES

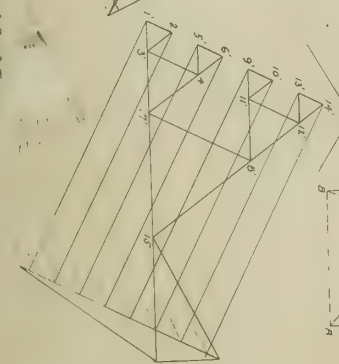
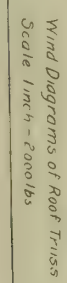
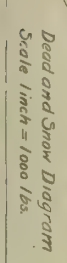
Member	Dead Load	Wind Ld Case A	Wind Ld Case B	Max Stress
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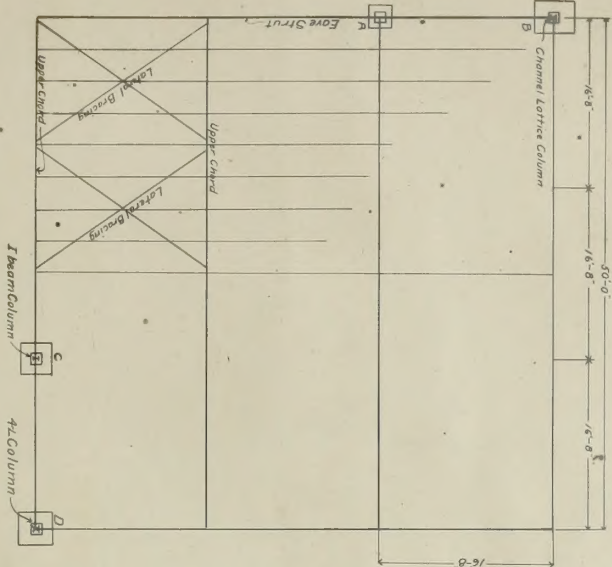
Dimensions

FOR A

Adm. Bd.
CITY OF MI.

Plate 1

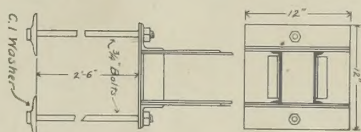




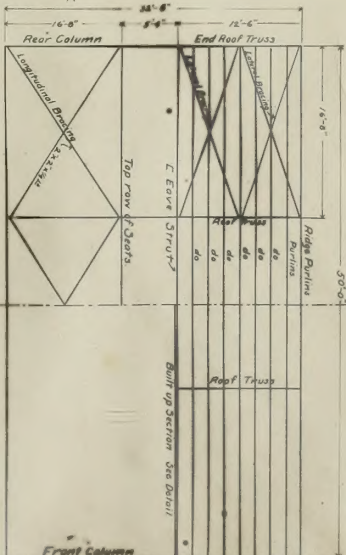
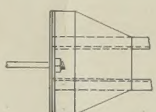
PLAN OF UPPER FLOOR

PLAN OF FOUNDATION

PLANS OF A 50 FT SECTION



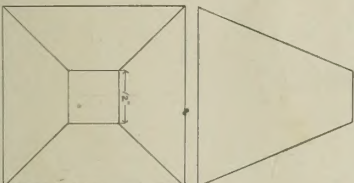
DETAIL OF COLUMN BASE



REAR ELEVATION

FRONT ELEVATION

ELEVATION OF A 50 FT SECTION



DETAIL OF FOUNDATIONS

NOTE: All foundations made of concrete with 1/2" dia. bars. Foundations of bases are 10'-3/4" x 10'-3/4" x 10'-3/4".

PLANS AND ELEVATIONS

FOR A
50 FT SECTION
OF A

GRAND STAND

DESIGNED BY

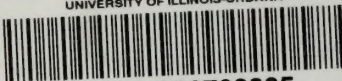
B. C. Bunge

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